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Bowker, William Henry

The problem of fertility in
the middle west

[Boston, Mass.?)

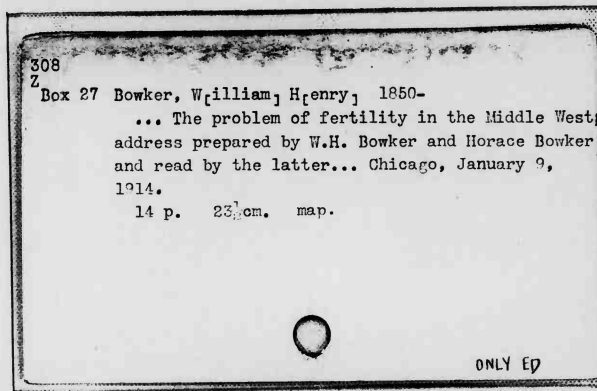
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*Gift
Prof. H. H. Carpenter
June 1915*

"Read not to contradict and to confute
nor to believe and take for granted, but to
weigh and consider." (Bacon.)

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Box 27

The Problem of Fertility In the Middle West



Address prepared by W. H. Bowker and Horace Bowker and
read by the latter at a Luncheon given to representative Bankers
and Railroad Men by the Middle West Soil Improvement Com-
mittee of The National Fertilizer Association, in Chicago
January 9, 1914.

Mr. 31, 1916-03 03

THE PROBLEM OF FERTILITY IN THE MIDDLE WEST

We are met here to discuss fertility or commercial plant foods, the product of the plant food industry. It is the province of our industry to send its ships to the four quarters of the globe to gather fertility and to render it available for man's use. We are now tapping the air for nitrogen, of which there are 35,000 tons hanging over each acre of the earth's surface, — an exhaustless reservoir, soon to be extensively utilized to restore the nitrogen which has been sent abroad in the shape of cattle and cereals.

Liebig's Great Discovery

About seventy-three years ago a chemist, Baron Von Liebig, discovered that bone dissolved in sulphuric acid was more available for plants than the raw bone. Bone and wood ashes had been used as fertilizers for ages, but it was known that bone was slow-acting, that it did not render up its plant food readily enough. It was known that plants took their nourishment from the soil in solution, and must have most of it *during 60 days of the growing season*. It was known that bone was not soluble in water. Liebig reasoned that if it could be made soluble in water, plants would assimilate it more readily. He found by treating bone (a three-lime phosphate) with sulphuric acid, that he took away two parts of lime, forming sulphate of lime, or land plaster, and left the remaining part of lime in combination with phosphorus as a one-lime phosphate which was soluble in water, a form easily assimilated by growing crops, and which would produce an earlier and more vigorous growth. He called this product Superphosphate of Lime. It was one of the great discoveries of the ages, and the beginning of the fertilizer industry. Thus you see that chemistry is the basis of the industry.

Sources of Commercial Plant Foods

Let us consider the chemical elements in which the fertilizer industry deals. It is known that crops require some thirteen elements for their growth, ranging from nitrogen to iron. It is known that soil and air are abundantly supplied with most of them; that through continuous cropping, without adequate returns, most soils are deficient in nitrogen, phosphorus, potassium, and in some cases lacking in lime and sulphur; that as a rule, the three which we need to supply, *the great trio*, are nitrogen, phosphorus and potash.

Thus we have searched the world for sources of phosphorus, contained in phosphate of lime. We have found enormous quantities of phosphates in the Carolinas, in Florida, in Tennessee, and now in Wyoming and Montana. We have mined this phosphate, washed it, and ground it, and following the discovery of Liebig, we have dissolved it and converted it into a superphosphate, now popularly known as Acid Phosphate.

We have searched the earth for potash to take the place of the potash which we used to get in wood ashes, and so far we have found only one available source, in Germany, and that seems to be inexhaustible. But it is a monopoly, and we are made to pay much more for it than we should pay.

We have searched the world for nitrogen, the most costly element of plant food, and we have found it in the enormous nitrate deposits of Chili, and in the coal deposits of Pennsylvania, Ohio, and Illinois, or wherever there is soft coal which can be used for coking purposes. This we are recovering in the form of sulphate of ammonia, the use of which should be encouraged, for the reason that it is not only an excellent source of nitrogen, but it is a home source, lying right here under our feet, by the use of which we can build up our agriculture and keep at home some part of the millions we are now sending abroad for nitrogen, — an economic proposition from any angle you view it.

We also find nitrogen in the by-products of our packing houses and fisheries, — in the immense quantities of tankages, waste meat and waste fish, which are converted into fertilizers. We also find it in seed meals, like cotton seed and linseed; but these and the tankages are now being used so extensively for feeding purposes that they are not a dependable source.

Finally in our search for nitrogen we come to the atmosphere, the greatest source of all. Recent discoveries are rendering available the nitrogen of the atmosphere in a chemical known

as Cyanamid, and also in Nitrate of Lime, but the utilization of atmospheric nitrogen at present depends upon a high degree of heat, which can be generated only by means of an electrical current. Where cheap water power is abundant and an electrical current can be generated at low cost, which cannot be sold for lighting or manufacturing purposes, at that point it can be utilized to extract nitrogen from the atmosphere. A plant is in successful operation at Niagara Falls and one in Norway. Also plans are under way for developing the great water powers in the Blue Ridge mountains for this purpose. A scheme is also reported in the newspapers to utilize Grand Falls in Labrador for extracting atmospheric nitrogen.

Another source of nitrogen is the leguminous crops grown by farmers, whereby soil bacteria are utilized. It is known that no plant can thrive *above* the earth unless smaller plants, known as bacteria, are growing *in* the earth, — in other words, a lower order of life, which yields up its life to a higher order in the shape of farm crops, which in turn yield up *their life* that men and animals may exist, thus rounding out a marvelous cycle, the connecting links of which we are just beginning to study, and in a small way, to comprehend.

So we see that the fertilizer industry is something more than mixing a few ingredients together with a shovel on a barn floor. If you men have to deal with commercial, labor and engineering problems, we have all these, and in addition we must know something of the applied sciences, such as chemistry, mineralogy, botany, and bacteriology. If one will take the time to go through a modern fertilizer plant and note its furnaces, lead chambers, retorts and towers, its crushers and grinders, he will see that it is something more than a mixing mill and warehouse.

Lawes, the Founder of the Industry

We spoke of Liebig being the inventor of Superphosphate of Lime, the basis of the business, yet the real founder of the fertilizer industry, as an industry, was Sir John Lawes of England. He claims to have discovered superphosphate simultaneously with Liebig, but whether he did or not, he was the first man to begin the manufacture of mineral phosphates (the Cambridge coprolites of England) into superphosphate or acid phosphate, and to add nitrogen to it in the shape of sulphate and muriate of ammonia. Later, potash in the shape of German salts was added, making what is now called the "complete fertilizer."

Lawes made a large fortune in the business, a portion of which he devoted to the maintenance of an experiment station on his own estate, Rothamsted, which he inherited. For more than sixty years he conducted a series of experiments with all sorts of fertilizers and fertilizing materials and reported them so accurately and so fairly, no matter whether for or against commercial fertilizers, that they have been accepted as authoritative throughout the world. His work was so good that he was knighted by Queen Victoria and since his death the Rothamsted station has been taken over by the Government, and is now conducted as a public experiment station, much like our state experiment stations.

Now the fertilizing industry the world over has copied Lawes, and is making exactly the same things which he made, and which the Lawes Manure Company is making today in England, so if we are not making good things the blame must rest with Lawes, whom we have imitated. By some critics complete fertilizers have been called "soil stimulants" and "patent soil medicines," and for that reason the public is sometimes warned against them. If they are stimulants like rum why should Lawes be praised for manufacturing them, and we, in this country, condemned for doing the same thing? To laud the one and condemn the other is inconsistent, to say the least.

The Evolution of the "Complete" Fertilizer

Let us consider what a so-called complete fertilizer really is, containing the three leading elements, nitrogen, phosphorus, and potash. It is an evolution. Liebig started with ground bone, which contains nitrogen and phosphate of lime. He took practically a thousand pounds of bone and added a thousand pounds of sulphuric acid, the thousand pounds of bone originally containing 4% of nitrogen and 20% of phosphoric acid. When he added the thousand pounds of sulphuric acid he divided the result by two and the final product of dissolved bone contained, therefore, approximately 2% of nitrogen and 10% of phosphoric acid. In the trade today it is what is called a 2-10 goods.

What was the next step? Somebody added some concentrated potash, and then we had the "complete" fertilizer containing nitrogen, soluble phosphorus, and potash, or practically a 2-8-2 goods, *dissolved bone with potash*, which some of our critics affect to call a soil or plant stimulant.

Milk is a complete food, containing the three leading elements of food; namely, protein, in the shape of cheese, fat in the shape of cream, and sugar in the shape of milk sugar. Would you call it a stimulant because of that fact?

There is no such thing as a stimulant to plants in the sense that alcohol is a stimulant to man. Fertilizers are available plant food. They encourage and sustain growth because they are largely soluble in water, and are easily assimilated by plants, as milk is easily assimilated by children. Fertilizers are "liquid assets" which are as essential in the soil as in business. Crops are living things; they want what they want *as* and *when* they want it; failing of it they "go broke." There are some who go so far as to say that anything is a stimulant to plants which makes them grow. In that sense, water, the greatest known solvent, is a stimulant, and sunshine is a stimulant, and the electric light may yet prove to be a stimulant. However, to satirize fertilizers by classing them with rum is neither scientific nor fair.

The "Filler" in Fertilizers

A great many people think fertilizers contain "filler" or extraneous material. They are encouraged to think so by those interested in the sale of chemicals produced in and outside of this country. When Liebig added 1,000 pounds of sulphuric acid to 1,000 pounds of bone, he practically had a ton of half the strength of the original bone, but it had been rendered soluble hence much more valuable. In the process there is some shrinkage, perhaps 10% or 200 pounds, which gives room to add potash in the form of a German potash salt, and then the ton is rounded out and the mixture is a "complete fertilizer," containing the three elements, — nitrogen, *available* phosphorus, and potash, *but where is the filler*—that bugbear, that scarecrow, that thing which is held up by some of our critics to discredit our wares? There was no filler in Liebig's Dissolved Bone or in Lawes' "Complete Fertilizer" made from dissolved bone, for there was no room for any; and there is practically no filler in fertilizers today, for the reason that there is little or no room for any. Moreover, there is another and more potent reason, namely, it costs money to assemble and prepare extraneous matter, even common sand, when by proper balancing of materials it is not necessary. A chemist who figured his formulas so that it cost 25 cents or even 10 cents a ton "to fill up" would soon lose his job.

Did it ever occur to you that only 15% of pure milk is solids or *food*, and that the remaining 85% is water? Can you separate the water from the milk and still have a white, limpid fluid? The water in milk is the "normal water of composition" which holds and carries the actual nourishment of milk. So in fertilizers, take nitrate of soda, one of the most popular fertilizer chemicals; 100 lbs. contains 15 pounds of nitrogen; the remaining 85 pounds is the "normal oxygen, soda and water of composition." Take the most concentrated fertilizer chemical salt in use, namely, muriate of potash. It contains only 50 pounds of potash in the hundred pounds.

Finally, take one of the most concentrated complete fertilizers which the industry puts out; it contains but 25% of actual plant food in a ton, or 500 pounds of nitrogen, potash, and phosphoric acid added together. What is the remaining 1,500 pounds? Naturally one not familiar with chemistry thinks it is so called "filler" but it is nothing of the kind. It is made up of organic matter, salts, alkalis and acids, which are the carriers or containers of plant food, as the water of milk is the natural carrier of the food of milk, as the fibre of meat is the natural carrier of the protein and fat of meat. And right here it is well to observe that one of the medium grades of fertilizer on the market, 3-8-4, which equals 15 units of plant food to a ton, is exactly the same number of units that nitrate of soda contains. Does anyone claim that nitrate contains any filler in the popular sense of that term because it carries only 15 units or 300 pounds of plant food in a ton?

It may be urged that by using concentrated chemicals one can make the same grade with two-thirds of the bulk. So he can in some cases, but such mixtures would cake and would not be drillable in a machine. Moreover, they would not supply the forms of plant food which crops need. Besides, the exclusive use of these concentrated chemicals would displace just so much by-product plant foods, which it is good to use, both from the standpoint of economy and from that of making stable, drillable goods. No sound economist or wise agronomist advises the exclusive use of concentrated chemicals any more than he would advise the exclusive use of concentrates in the feeding of live stock.

We have gone into this matter with some detail because the imputation of the use of fillers is so often thrown up against the industry to injure it. Now while we do not say that fillers are never

used, it is the exception rather than the rule, and the exceptions are usually where they are needed as "conditioners" and in that case they are usually such materials as not infrequently contribute to the sum total of plant food. Fillers, in the shape of extraneous matter, would be disclosed in the analysis, which rarely occurs. *As a matter of fact, they exist chiefly in the imagination of the critics.*

Barren (?) East and Fertile (?) West Compared

It has been said that where fertilizers have been used longest in the East, there the soil is worn out. The Crop Census does not show it. On the contrary, where attention is paid to rotation of crops, and to keeping up the humus, the Census shows that the East is producing, even of the staple crops, much more per acre than is grown in the Middle West*. Moreover, where fertilizers have been used extensively and intelligently, there the soils are increasing in fertility and agriculture is prospering. In Europe they find it *pays to make a fertile soil still more fertile* by the use of chemical fertilizers. Gov. Herrick, our minister to France, writes:

"All the states along the Atlantic seaboard now use commercial fertilizers. Eventually there will not be an acre in the Nation that cannot profitably use fertilizers. If used in the smallest European proportions of \$6 to the acre, the aggregate sum bulks so large as to stagger the imagination."

Fertilizers Serve Other Purposes

Commercial fertilizers, in addition to supplying plant food, serve other purposes which are often lost sight of. Because they supply this food in soluble, active forms, they improve quality; as in the case of grains, they stiffen the straw and fill out kernels; but what is quite as important, they hasten maturity, reducing the percentage of soft corn or wheat. Oftentimes they are the best *crop insurance* a farmer can employ.

In New England, commercial fertilizers were first used as "starters," as concentrated foods are used to start a calf to an early vigorous maturity. Before the days of dissolved bone they could not raise corn successfully in New Hampshire. The seasons, as a rule, were not long enough to mature it. Now almost every county in the state has its corn king who raises more corn per acre than the average yield of the Corn Belt.

*See Addenda.

New Hampshire, according to the Census, produced in 1910 46 bushels of corn to Illinois' 39 bushels per acre, and Iowa's 37 bushels.

Thirty years ago they came near giving up the growing of wheat in the Genesee Valley in New York, because of the ravages of the Hessian fly. Someone tried commercial fertilizer and found it hastened the growth of the wheat plant so that it got ahead of the fly and for years the wheat industry in the Genesee Valley was preserved. Now commercial manures are used extensively in that valley on every variety of crop.

Sole Source of Fertility

In the East, from the use of fertilizers for a particular purpose on a particular crop, their use has extended to all crops and in many cases they have become the sole source of applied fertility. Take for example the potato crop. It was discovered that better potatoes could be grown on fertilizers than on stable manure and the result is that in Aroostook County, Maine, more than 25,000,000 bushels of potatoes are grown exclusively on high grade commercial fertilizer. They are producing in that county 300 bushels per acre against 92 in the Middle West. The county reminds one of Iowa. Much of the land is recently cleared and all the soil is naturally fertile; but they find it pays to make it still more fertile by the liberal use of fertilizers. It is conservatively estimated that 60,000 tons are used each year in this one county. The bankers in Aroostook County will tell you that fertilizers have put that county on the map commercially as well as agriculturally.

A still better illustration is the cotton crop of the South. Any banker or railroad man will tell you that the South is absolutely dependent on the fertilizer industry to grow the cotton crop. It is true that they are not producing as much cotton per acre as they ought to produce and will produce with improved seed, crop rotation, and better methods of cultivation. It is also true that they are not producing in the South as much corn per acre as is being produced in Illinois and in New England, and we in New England are profitably producing on our so-called "exhausted farms" by the use of fertilizers, almost 50% more per acre than is being produced in the Corn Belt, or 45.5 bushels in New England to 32.8 bushels in the Corn Belt.

But the South will never produce corn so long as it can produce *cash crops* such as cotton, sugar, rice, and citrus fruits. And you in the Middle West ought to be thankful that it will not. It is

your place to grow the corn, the cattle, the wheat, and the oats, which the South cannot so well produce. Let each latitude grow the crops naturally adapted to it and in the end it will make for better conditions the country over.

Some Jolts and Some Boosts

New England has prided herself upon being advanced, but recently she has been jolted out of her complacency, the last severe jolt being the collapse of her railway systems. She has waked up to find that Chicago is competing with her in music and art, Indiana in literature, and Wisconsin in progressive legislation, while the Middle West is sending men to reorganize her railroads. The Middle West claimed for years, and justly so, that agriculturally it was the richest section in the country, but the last Census gave her also a bad jolt. It showed that she was falling behind in agricultural production, and in the number of resident farm owners. Viewed from the outside it would appear that the two most important questions in the Middle West are, how to increase production and how to deal with the tenant farmer.

A Boost,—J. J. Hill's Experiments

James J. Hill has conducted some wonder-working experiments with fertilizers, which have not received the attention they deserved in the West. Is it because the West does not want to admit that it needs rejuvenation, or is it because she is complacent? Hill showed in one season, by the use of fertilizers, that he could double the yield of cereals in the Middle Northwest. It matters not at this time whether it was done at a profit. The important thing is to demonstrate that yields can be doubled by a certain treatment. Thirty-six years ago Bell demonstrated that he could talk over a wire from one room to another. Today we know the result. The fertilizer industry has nothing to fear from such experiments as Hill's, even if all of them are not at first commercially successful. It has nothing to fear from any experiments provided they are carried on without bias and by men who have no hobby to ride.

Will it Pay? No Longer an Academic Question

The value of commercial plant food has passed beyond the experimental stage in Europe and in the eastern part of this country. Why not accept the testimony of seventy-five years

at Rohamsted, of fifty years at Halle, and of thirty years in Georgia and in Maine. I sometimes wonder if the agricultural teachers and writers in the West are not standing in the way of agricultural progress by still considering as an academic question the value and need of fertilizers. The question is not—Are commercial fertilizers good and useful?—*but will it pay to use them* as James J. Hill has done in his part of the country. To my mind, Mr. Hill has answered the question, "will it pay?" in the affirmative. By the use of a little over \$5 worth of fertilizer per acre he practically doubled the yield of wheat, oats and barley, and you can figure whether it paid or not. I wish that other railway officials might follow his splendid example.

The Hill experiments are along the lines of intensive agriculture. The fertilizer industry stands for intensive agriculture, which includes good seed, thorough cultivation, rotation of crops, cover crops, and the plowing in of green crops wherever it is necessary to keep up the humus of the soil. Its best fields are where the best agricultural practice is in vogue.

The Industry vs. Criticism

The industry knows its own shortcomings and it is not unmindful of the benefits of criticism, but in the face of criticism and opposition it has grown in the last forty years from half a million to nearly 7,000,000 tons. In the last five year Census period the use of complete fertilizer increased 104 per cent.

Criticism and ridicule which retards the day of the introduction and use of commercial plant foods in the Middle West serves no economic purpose. It is as shortsighted as it is unsound. In Europe, government-paid officials and teachers who are unfair to legitimate industry are the exception. State and Federal paid teachers who call fertilizers "soil stimulants," and "patent soil medicines," who imply that they are composed of "fillers," and who deliberately exaggerate the profits of the industry to discourage their use, are not fair, to say the least. They neither serve the true interests of agriculture nor promote the welfare of the Nation which employs them.

It would seem that an industry which has stood the test of three-quarters of a century, that conserves every pound of plant food it can find, that delves in the earth and taps the air in order that more abundant and cheaper fertility may be supplied, is an industry that is quite worth while.

ADDENDA

SOME JOLTS AND SOME BOOSTS

Taken from the Census and from Experiments

According to 1910 Census Bulletin "Agriculture," page 18:

The average yield of Corn in New England increased from 39.4 bu. per acre to 45.2 bu. or nearly 15%
 In Illinois the yield stood still at 38.8 bu.
 In Iowa it dropped from 39.1 bu. to 37.1 bu. or 5%.
 In Kansas it dropped from 27.8 bu. to 19.1 bu. or 31%.
 In Nebraska it dropped from 28.8 bu. to 24.8 bu. or nearly 14%.
 In Missouri it dropped from 28.1 bu. to 26.9 bu. or 4%.
 It is suggested that better seed, better cultivation and added fertility from some source would improve conditions, as the same things have done in New England and in Old England.

JAMES J. HILL'S

Wonder Working Experiments with Fertilizers

(Condensed from World's Work, April, 1913)

In one year Mr. Hill demonstrated in the middle North West that he could practically double the yield of wheat, barley and oats by the use of fertilizers. The experiment was tried on five-acre plats on 151 farms (755 acres in all) scattered along the Great Northern route in Minnesota and North Dakota, the most extensive practical experiment the world has ever seen, as follows:

Average of the Great Northern Plats With Fertilizer	U. S. Census Average of Minnesota and No. Dakota without Fertilizer	Increase
Wheat 30 bu. per acre	Wheat 15.8 bu. per acre	14.2
Barley 47 " " "	Barley 21.9 " " "	25.1
Oats 71 " " "	Oats 31. " " "	40.

The grain in each case from the fertilizer plats was much superior in quality and brought a higher price. Each acre received \$5.39 worth of fertilizer. It can easily be calculated whether the increased yield paid or not. It is the experience the world over where commercial plant foods are used intelligently, that not only are larger yields of better quality obtained, but the land steadily increases in productiveness.

WHEAT EXPERIMENTS

In England, Pennsylvania, Ohio and Illinois

Dr. Cyril G. Hopkins of the University of Illinois gives the following statistics in "Science," October 3, 1913:

England — As an average of 60 years where wheat has been grown year after year on the same land at Rothamsted:

Unfertilized Land produced	12.6 bu. per acre
Farm Manure produced	35.4 " " "
Commercial Plant Food produced	37. " " "

Pennsylvania — As an average of 24 years the wheat yields at Pennsylvania State College, when grown in a four-year rotation, varied as follows:

Unfertilized Land produced	10.1 bu. per acre
Farm Manure produced	24.1 " " "
Commercial Plant Food produced	24.8 " " "

Ohio — As an average of 19 years the wheat yield at the Ohio Experiment Station, the wheat being grown in a five-year rotation with clover, timothy, corn and oats on five different series of plots, so that every crop might be represented every year.

Unfertilized Land produced	10.2 bu. per acre
Farm Manure produced	21.7 " " "
Commercial Plant Food produced	26.9 " " "

Illinois — On five Experiment fields of the University of Illinois, located in different parts of the state the following results with wheat are given for 1913.

Unfertilized average of the 5 fields	13.1 bu. per acre
Fertilized with Organic Manures, Limestone, Phosphorus and Potassium, average of 5 fields	32.3 " " "

Average increase	19.2 " " "
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NEW ENGLAND AND THE MIDDLE WEST COMPARED

The following figures are based on the U. S. Census

	Corn (Av. Bu.) per acre	Wheat (Av. Bu.) per acre	Potatoes (Av. Bu.) per acre
<i>New England</i> , using \$1.30 worth of fertilizer per acre of improved land, produces	45.	24.	177.
<i>The Middle West States</i> , using 4 cents worth of fertilizer per acre of improved land, produce	33.	17.	92.
<i>Maine</i> , using \$1.72 worth of fertilizer per acre of improved land, produces	43.	25.	210.

According to 1910 Census Bulletin "Agriculture," page 18:

The average yield of Corn in New England increased from 39.4 bu. per acre to 45.2 bu. or nearly 15%.

In Illinois the yield stood still at 38.9 bu.

In Iowa it dropped from 39.1 bu. to 37.1 bu. or 5%.

In Kansas it dropped from 27.8 bu. to 19.1 bu. or 31%.

In Nebraska it dropped from 28.8 bu. to 24.8 bu. or nearly 14%.

In Missouri it dropped from 28.1 bu. to 26.9 bu. or 4%.

It is suggested that better seed, better cultivation and added fertility from some source would improve conditions as the same thing have done in New England and in Old England.

EXPENDITURES OF FARMERS FOR FERTILIZER IN 1909

1 DOT = \$5,000

How the use of Fertilizers has Increased in the United States in the past Ten Years.

(From U. S. Census 1910)

	1899	1909	Amount of Increase	Per Cent Increase
UNITED STATES	53,430,910	114,882,541	61,451,631	115.0%
New England States	4,297,705	9,407,759	5,110,054	118.9%
Middle Atlantic	11,344,290	18,221,474	6,877,184	60.6%
South Atlantic	22,732,670	59,425,130	36,692,460	162.3%
East North Central (O., Ind., Ill., Mich., Wis.)	5,866,520	8,058,881	2,192,361	37.4%
West North Central (Minn., Ia., Mo., N. D., S. D., Neb., Kansas)	1,407,175	983,216	(Decrease) 423,959	(Decrease) 30.1%

East and West Compared

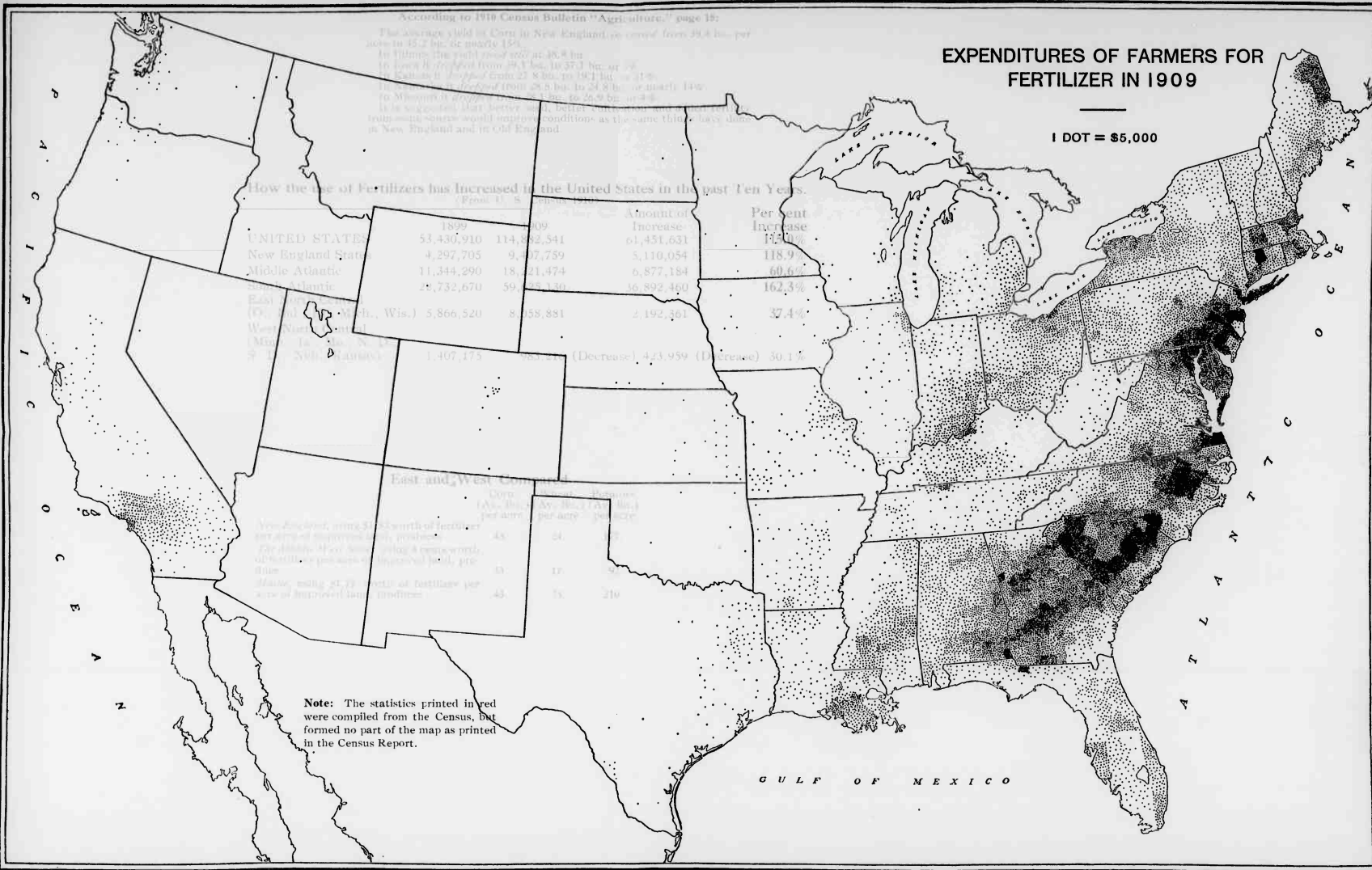
	Corn (Av. Bu. per acre)	Wheat (Av. Bu. per acre)	Potatoes (Av. Bu. per acre)
New England, using \$1.30 worth of fertilizer per acre of improved land, produces	45.	24.	17.
The Middle West States, using 4 cents worth of fertilizer per acre of improved land, produce	33.	17.	92.
Maine, using \$1.72 worth of fertilizer per acre of improved land, produces	43.	25.	210.

Note: The statistics printed in red were compiled from the Census, but formed no part of the map as printed in the Census Report.

INTENTIONAL SECOND EXPOSURE

Thirteenth Census of the United States: 1910.

Department of Commerce, Bureau of the Census.



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